Document ID:EDF-3273
Revision ID:0
Effective Date:06/25/03

## Engineering Design File

PROJECT NO. 23052

# TRU Constituent Calculations and the Proposed Disposal Path for the VES-SFE-20 Hot Waste Tank and Contents

Prepared for:
U.S. Department of Energy
Idaho Operations Office
Idaho Falls, Idaho


Idaho National Engineering
and Environmental Laboratory

Form 412.14
04/03/2003
Rev. 04

# ENGINEERING DESIGN FILE



EDF No.: 3273 EDF Rev. No.: 0 Project File No.: 23052

1. Title: TRU Constituent Calculations and the Proposed Disposal Path for the VES-SFE-20 Hot Waste Tank and Contents Page 1 of 1

2. Index Codes:
Building/Type CPP-642 SSC ID VES-SFE-20 Site Area INTEC

3. NPH Performance Category: _____ or ☒ N/A

4. EDF Safety Category: _____ or ☒ N/A SCC Safety Category: _____ or ☐ N/A

5. Summary:
This Engineering Design File documents the calculations for determining the Storage Facility Exterior-20 tank weight and contents weight. This Engineering Design File also addresses the rational for determining the transuranic concentrations for the entire waste package, based on prior characterization data, and presenting the proposed treatment and disposal path(s).

6. Review (R) and Approval (A) and Acceptance (Ac) Signatures:
(See instructions for definitions of terms and significance of signatures.)

| | R/A | Typed Name/Organization | Signature | Date |
|---|---|---|---|---|
| Performer/ Author | N/A | J. L. Bragassa/3150 | J. L. Bragassa | 6/18/03 |
| Technical Checker | R | M. D. Varvel/3150 | | 6/18/03 |
| Independent Peer Reviewer (if applicable) | R | M. H. Doornbos/ORB Review Chair | | 6/25/03 |
| Approver | A | C. J. Hurst/3150 | | 6/23/03 |
| Requestor (if applicable) | Ac | L. Davison/Program Manager/3150 | | 6/24/03 |
| Author | | R. S. Rice/Waste Generator Services/3150 | | 6/24/03 |
| | | | | |
| Doc. Control | AC | Annie Buttars/3100 | | 6/25/03 |
| 7. Distribution: (Name and Mail Stop) | | | | |

8. Does document contain sensitive unclassified information? ☐ Yes ☒ No
If Yes, what category:

9. Can document be externally distributed? ☒ Yes ☐ No

10. Uniform File Code: ~~UFC-8201~~ 6102 mw 6-25-03 Disposition Authority: ~~A17-31 a-1~~ ENVI-h-1 mw 6-25-03
Record Retention Period: See LST-9

11. For QA Records Classification Only: ☐ Lifetime ☐ Nonpermanent ☐ Permanent
Item and activity to which the QA Record apply: NA

12. NRC related? ☐ Yes ☒ No

13. Registered Professional Engineer's Stamp (if required) N/A

This page is intentionally left blank.

# CONTENTS



# FIGURES

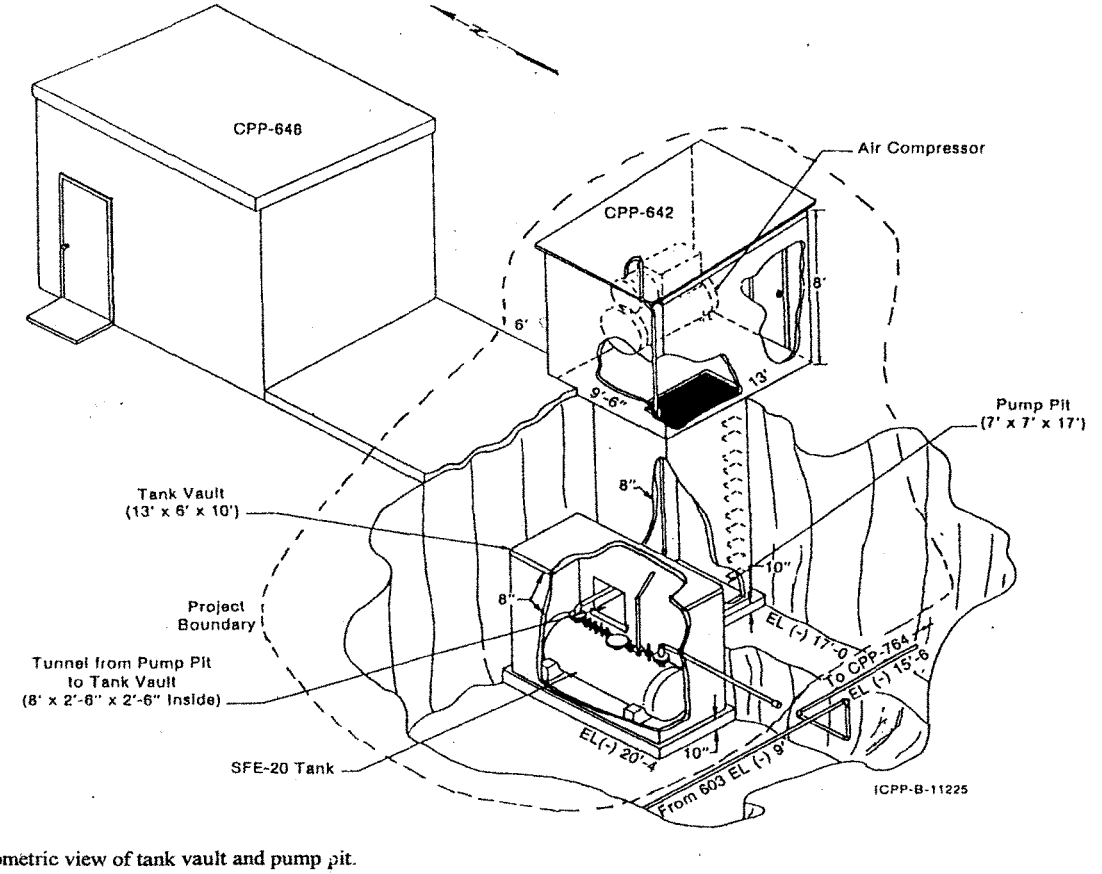
This page is intentionally left blank.

# TRU Constituent Calculations and the Proposed Disposal Path for the VES-SFE-20 Hot Waste Tank and Contents

## 1. INTRODUCTION

The Vessel-Storage Facility Exterior (VES-SFE)-20 Hot Waste Tank is located in the Idaho Nuclear Technology and Engineering Center's (INTEC's) south basin area of CPP-603, an environmentally controlled area known as CPP-69. The tank system was built in 1957 to collect low-level liquid wastes resulting from the receipt, storage, and cutting of aluminum-clad fuel from the Savannah River Test Reactor Program. The fuel cutting activities began in 1959 and lasted until 1962. Acid was added to the VES-SFE-20 tank at the end of the fuel cutting operations and the contents of the tank were heated in an attempt to dissolve any aluminum fuel fines resulting from the cutting process. The tank was taken out of service in 1976. The remaining contents of the tank were sampled in 1984 for the purpose of characterization (Analytical Laboratory Log 84-021529).

The SFE-20 tank system consists of the VES-SFE-20 tank, the tank contents, and associated structures located east of Building CPP-603. An isometric view of the tank and vault and pump pit is shown in Figure 1.




Isometric view of tank vault and pump pit.

Figure 1. Isometric view of the tank vault and pump pit.

Under the WAG 3, Group 7 project, the VES-SFE-20 tank and tank contents will be removed from the tank vault and disposed of in an approved disposal facility. The tank contents consist of approximately 33 gal of sediment or a hard heel 3-4 in. in depth (DOE-ID 2002). This document discusses two proposed disposal paths for the tank and its contents. One disposal path assumes the waste package is Resource Conservation and Recovery Act (RCRA) regulated; the other path assumes the waste package is not RCRA regulated (see Section 6).

## 2. METHODOLOGY

In accordance with the Record of Decision (ROD) for the VES-SFE-20 Hot Waste Tank, the tank and contents will be removed and treated off-Site and disposed of at an appropriate disposal facility.

This Engineering Design File (EDF) provides the rationale for the proposed disposal paths for the tank and its contents. First, it discusses the basis for determining the transuranic (TRU) concentrations for the waste package. Second, the mass calculations for the tank and tank contents are presented. Third, the calculations for determining the TRU concentrations of the waste package(s) are presented for determining if the waste package is below 10 nCi/g, between 10 and 100 nCi/g, or above 100 nCi/g (or TRU waste). Lastly, the EDF will present the two proposed pathways for the treatment and disposal of the waste package based on the 1984 waste stream characteristics. Note that the radionuclide information used in the calculations is from sampling done in 1984 and may not be representative of the sediment. Therefore, this EDF information will be assessed when new sampling data from the sediment is obtained to determine if any revisions are necessary.

## 3. DETERMINING RADIONUCLIDE CONCENTRATIONS

Guidance for determining concentrations of radioactive waste is found in the Nuclear Regulatory Commission's (NRC's) *Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation, Revision in Part to Waste Classification Technical Position* (NRC 1995). The technical position was issued for purposes of documenting the NRC's position regarding the application of "averaging" for purposes of determining the waste category in accordance with its promulgated regulation 10 CFR 61.55. The regulation establishes a waste classification system based on the concentration of specific radionuclides contained in the waste. The regulation states that, for the purposes of waste classification, the concentration of a radionuclide may be averaged over the volume of the waste, or weight of the waste, for those concentration units, in 10 CFR 61.55, Table 1, that are expressed as nanocuries per gram.

In addition, guidance found in DOE G 435.1-1 dictates, "the mass over which the activity is divided in making the waste determination is the waste matrix." The waste matrix includes the waste material itself as well as any stabilization media that must be added to meet Waste Acceptance Criteria (WAC) for mobility, physical form, structural stability, or free liquids. The mass of added shielding, the container, or any rigid liners is not included in the calculation. Additionally, the guidance says, "the determination of transuranic waste should be made at the time of waste certification, that is, each time the waste is transferred to another person or facility." This document will look at two waste certifications for the waste package. The first waste certification will be when the waste package is transferred from the INEEL to a treatment facility. A second waste transfer will occur from the treatment facility to the disposal facility.

The following guidance was taken from the NRC's technical position on averaging (NRC 1995). For disposal purposes, calculations of the radionuclide concentrations for waste are to be determined based upon the volume or weight of the final waste form. Samples may be taken for analysis either from the final waste form or from the waste prior to processing into a final waste form.

For the purpose of waste classification of large unpackaged components (e.g., pumps and heat exchangers), the concentration of a radionuclide may be averaged over the volume of the component. Where items are placed in a container, however, and the volume of the container is at least 10% greater than the waste, then the volume used for waste classification should be that of the waste and not the gross volume of the container.

This radioactive waste classification guidance is depicted in the following example:

A tank contains a radioactive heel. If the heel will not be removed but is to remain with the tank structure for disposal, then the mass of the tank structure and the heel may be added together to determine the concentration of radionuclides in the waste. The void spaces must be eliminated (e.g., crush or grout in the tank) before the waste is disposed. If the heel is to be removed separately, then the heel must be classified separately from the tank structure.

The first waste certification, transfer from the INEEL to a treatment facility, will be based on a waste package containing a tank and radioactive heel (sediment). The current assumption is that the heel will not be removed, but will remain with the tank structure for disposal due to the increased risk to the health and safety of workers if the heel was to be removed. Therefore, the waste package will be disposed as one unit and the mass of the tank structure and the heel will be added together to determine the concentration of transuranics in the waste package. This being the case, the TRU concentration is calculated be 23 nCi/g for the waste package transferring from the INEEL to the disposal facility. The TRU concentration for the waste package transferring from the treatment facility to the disposal facility is calculated to be 4 nCi/g. This calculation is based on grouting the tank to stabilize the tank contents and fill void space, and meet land disposal restrictions (LDRs) if the waste package is RCRA regulated. These calculations are explained in detail in the following sections.

# 4. TANK WEIGHT AND CONTENTS CALCULATIONS

## 4.1 Tank

The SFE-20 tank weight was calculated as follows:

- Tank size: 7 ft 5 in. length + end spheres, 3-ft 6-in. diameter (120 $ft^2$ of material).
- Circumferential area of cylinder portion of tank = $2\pi R = 2\pi\ (1.75) = 10.9955$ * the length shown on INEEL Drawing No. 105935 = 7 ft 5 in. = 81.55 $ft^2$.
- The area of a sphere is equal to $4\pi R^2 = 4(\pi)1.75^2 = 38.485$ $ft^2$. One half of each sphere is at each end therefore the total area is equal to 81.55 + 38.485 = 120.035 $ft^2$.
- 1/4-in. 304 L stainless steel, unit weight of 1/4 in. 304 L is 11.16 $lb/ft^2$.
- Tank-only weight estimated: (120 $ft^2$) * (11.16 $lb/ft^2$) = 1,340 lb.

## 4.2 Interior Piping and Flange Weight

Interior piping consists of 304 stainless schedule 40 pipe. See Appendix A for detailed piping and flange weight calculations.

- Based on the approximately 49.33 (linear ft) of pipe and the associated unit weight of each pipe, the total weight is 138 lb
- The flange weights are based on the diameter, thickness, and unit weight for each flange for a total of 73 lb
- The total weight of piping and flanges: 138 + 73 = 211 lb.

## 4.3 Total Weight of the Tank With Piping

- Tank weight + piping weight: 1,340 + 211 = 1,551 rounded to 1,550 lb.
- These values are based on INEEL Drawing No. 105935. Actual field conditions may vary by ±10%.

## 4.4 Sediment Volume and Weight

The information in this section is taken directly from EDF-2381, "Miscellaneous Characterization Data for Hazard Classification of OU 3-13, Group 7, Hot Waste Tank VES-SFE-20."

On June 19, 2002, a 1/4-in. Toshiba camera was inserted into the VES-SFE-20 Hot Waste Tank through a 2-in. vent line. The camera was lowered to touch the top of the sediment, and based on marked measurements on the camera cord and the design diameter of the tank, the sediment was determined to be 3-4 in. in depth. For estimating the sediment volume and weight the following calculations were performed:

The volume of sludge in the tank was determined by conservatively assuming the following:

- A sludge height of 4 in. from the bottom of the tank
- The sludge height is consistent and level throughout the tank
- The tank ends are vertical rather than rounded
- The tank length is 113 in.
- Steam lines play an insignificant role in sludge volume determination.

Figure 2 shows a schematic depiction of the tank, dimensions, and assumed area for estimating the volume of sludge.

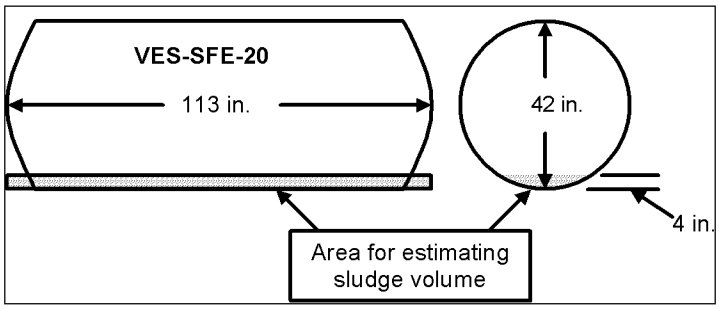



Figure 2. Schematic depiction of the VES-SFE-20 hot waste tank with assumed dimensions for estimating sludge volume.

In order to determine the volume of the shaded area depicted in Figure 2, the following equation was derived from the method for determining the area of a circular segment:

$$V = \left\{r^2 * [2 * ((\arccos[(r-d)/r])) - \sin(2 * ((\arccos[(r-d)/r])))]\right\} * \frac{l}{2}$$

where:

$V$ = Volume of sludge (shaded area depicted in Figure 1)

$r$ = Radius of interior tank (21 in.)

$d$ = Estimated depth of sludge (4 in.)

$l$ = Assumed length of tank (113 in.).

**NOTE:** All angle functions are calculated using radians rather than degrees.

Substituting the above values yields

$$V = \left\{21^2 * [2 * ((\arccos[(21-4)/21])) - \sin(2 * ((\arccos[(21-4)/21])))]\right\} * \frac{113}{2}$$

$$V = \{441 * [2 * ((\arccos[0.81])) - \sin(2 * ((\arccos[0.81])))]\} * 56.5$$

$$V = \{441 * [1.25 - 0.95]\} * 56.5$$

$$V = 7{,}475\ in.^3 = 32.4\ gal = 122.5\ L.$$

Thus, from the above calculation, the estimated volume of sludge remaining in VES-SFE-20 is 122.5 L (32.4 gal). To estimate a mass of sludge, it is necessary to make the following assumptions:

- The dry bulk density of the sludge is 1.5 g/cm$^3$
- The porosity of the sludge is 0.25
- Liquid with a density of 1.0 g/cm$^3$ fills the pore spaces of the sludge.

Based on the previously listed assumptions, the mass of sludge in VES-SFE-20 is determined as follows:

$$M = (\rho_l * \theta * V) + (\rho_s * (1-\theta) * V)$$

where:

$M$ = Total mass of sludge

$\rho_l$ = Density of liquid that fills pore space in sludge (1.0 g/cm$^3$)

$\rho_s$ = Dry bulk density of sludge (1.5 g/cm$^3$)

$\theta$ = Porosity of sludge (0.25)

$V$ = Volume of sludge (122,500 cm$^3$).

Substituting the above values into yields:

$$M = (1.0 * 0.25 * 122{,}500) + (1.5 * (1 - 0.25) * 122{,}500)$$

$$M = (30{,}625) + (137{,}813)$$

$$M = 168{,}438\ g = 371\ lb.$$

Therefore, the sediment mass is 371 lb. Using that figure, the approximate total weight of the waste package would be

- Tank/piping weight + sediment mass = total waste package weight
- 1,550 + 371 = 1,921 lb.

## 5. TRU CALCULATIONS FOR WASTE PACKAGES

In order to determine the TRU constituent level for the waste package transferring from the INEEL to the disposal facility, calculations were performed using the total waste package weight above. Information from the sediment sample gathered in the 1984 characterization effort estimated the TRU concentration level to be 117 nCi/g (EDF-2360). Therefore, in determining the TRU constituent's level for the waste package the following calculations were performed:

- TRU level of sediment: 117 nCi/g
- Sediment weight: ~371 lb ≅ 170,000 g
- Tank weight: ~1,550 lb ≅ 704,000 g

TRU level in sediment: (117 nCi/g)(170,000 g) = 19,890,000 nCi

Total weight of waste package: 170,000 g + 704,000 g = 874,000 g

TRU level in waste package: 19,890,000 nCi/874,000 g = 23 nCi/g.

Therefore, the TRU constituents level for the first waste package (tank and tank heel) is estimated to be 23 nCi/g and would be below the TRU concentration limit of 100 nCi/g.

For the second waste certification, transferring the treated waste package from the treatment facility to the disposal facility, the estimated TRU concentration calculations are shown below. The treatment facility will grout the tank to meet LDRs and the WAC (i.e., fill void space) for a designated disposal facility.

- Tank volume: 640 gal (the volume displaced by the piping was considered insignificant [< 5 gal] and thus was not factored into the tank volume)
- Sediment volume: 34 gal
- Remaining volume to be grouted: 606 gal
- 1 ft3 = 7.48 gal
- Grout volume: 606 gal/7.48 gal/$ft^3$ = 81 lb
- Assume unit weight of grout = 100 $ft^3$/ lb.

  Grout weight = (81 $ft^3$) * (100 $ft^3$ /lb) = 8,100 lb or 3,675,000 g.

  Total weight of tank, contents, and grout: 8,100 + 1,550 (empty tank) + 371 (sediment) = 10,021 lb.

  Total weight of grouted waste package in grams: 3,675,000 g + 170,000 g + 704,000 g = 4,549,000 g.

  TRU level in second waste package: 19,890,000 nCi/4,549,000 g = 4 nCi/g.

  Based on these calculations, the second waste package would have a TRU concentration level of 4 nCi/g.

# 6. PROPOSED DISPOSAL PATH FOR WASTE PACKAGE

Two proposed pathways are designated for the initial waste package; one for a RCRA regulated waste; and one for a non-RCRA regulated waste. An assumption is also made that the waste is contact-handled waste. Figure 3 identifies the treatment, storage, and disposal scenarios for various waste configurations. Since the actual characterization information is not available at this time, the table was developed to outline a path forward for the waste package and analyze the feasibility of each path. The current treatment and disposal facilities are identified for each waste scenario. In addition, Appendix B contains pertinent WAC from the identified disposal facilities.

## 6.1 RCRA-Regulated CERCLA Waste

As is shown, a RCRA regulated waste with a TRU concentration level of 23 nCi/g (Table 1, Box 3) would require treatment to meet LDRs and a disposal facilities requirements. The options for treating to meet LDRs are on-Site treatment (i.e., stabilization with grout) or off-Site treatment at an approved facility. One treatment facility that has been identified for the treatment of the waste package is Waste Control Specialists (WCS) of Texas. This company has the capability to grout the tank resulting in a waste form that will meet LDRs and the designated disposal facilities waste acceptance criteria. Another option is a permitted in-container process whose end result is a glass product. This option has been identified if the actual characterization data results show the volatile organic compound constituents are too high for the grouting method.

On-Site treatment was also looked at. Assurance that stabilization efforts would uniformly mix the grout with the sediment was low based on the INEEL's current resources in this area. Treatability and development efforts would have to be undertaken to pursue this path. Preliminary estimates for this avenue were approximately $2,000,000.

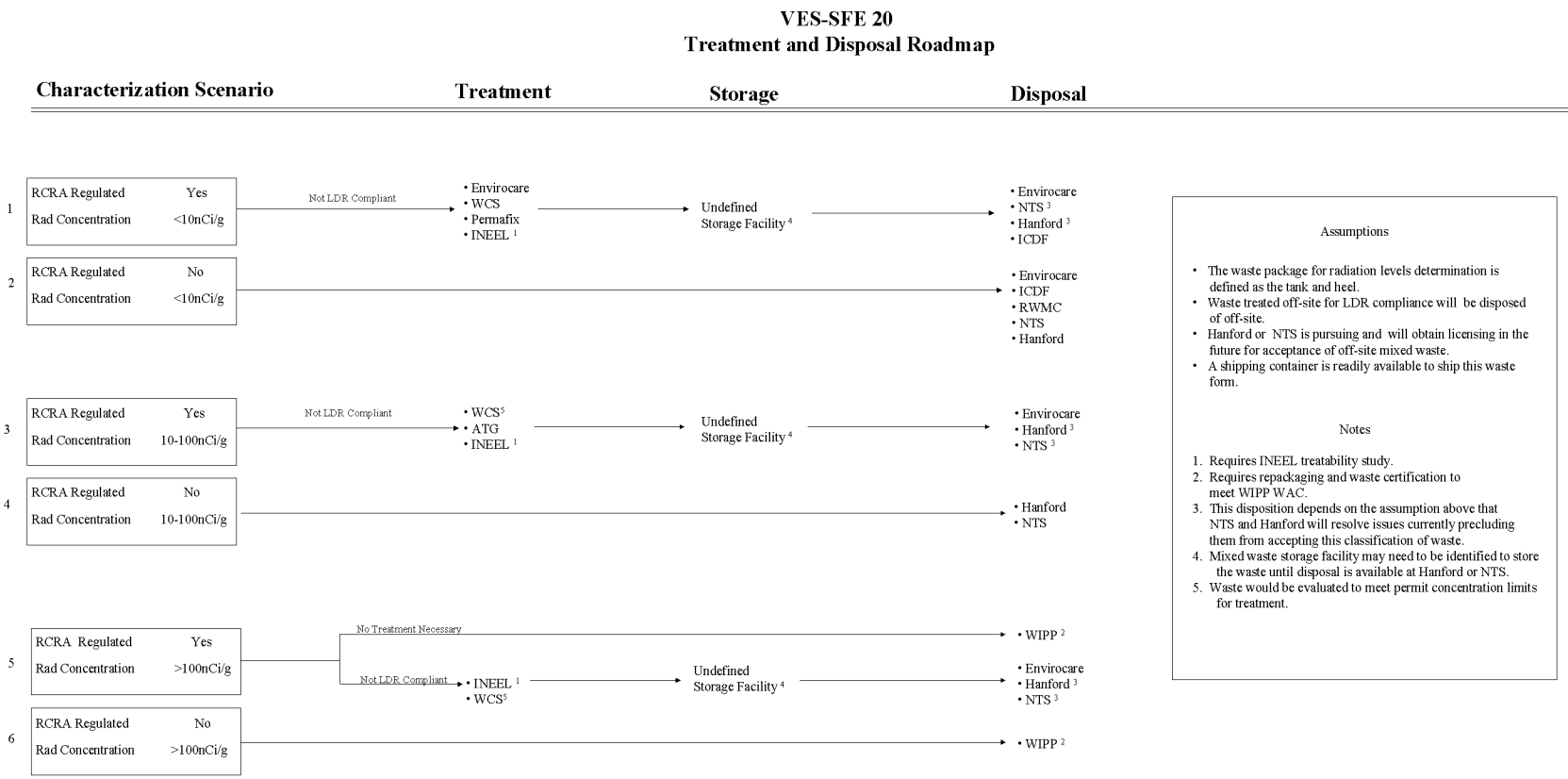



Figure 3. VES-SFE-20 waste package roadmap.

Since actual characterization data is not available as this time, the decision on a specific treatment technology will have to be made prior to actual remediation efforts; however, based on the limited 1984 characterization data, and workers safety, the proposed path of off-Site grouting to meet LDRs was deemed the "most probable" and cost-effective option. In addition, this option fully meets the requirement in the ROD to remove and treat the waste off-Site.

Now, for disposal options the second waste certification calculations are used. This is the transfer of the treated waste package from the treatment facility to the disposal facility. Based on the calculations above, the treated waste package would have a TRU constituent level of 4 nCi/g. The disposal options, from Box 1, are Envirocare, Hanford, Nevada Test Site, and the INEEL CERCLA Disposal Facility. At the present time, Hanford and Nevada cannot accept off-Site mixed waste but are pursuing licensing for future acceptance. The ICDF is not a feasible option based on conditions in the OU 3-13 ROD stating the "as found" sediment in the tank had to be <10 nCi/g and based on the 1984 data, the sediment is 117 nCi/g. Therefore, based on current assumptions and conditions, Envirocare is the proposed disposal facility. In reviewing their WAC, they are able to handle debris and dispose of a RCRA regulated waste form. Additionally, Envirocare has experience disposing of tanks. It shall be noted again that when actual characterization data is obtained, revisions to the current assumptions and conditions of the waste package will be made as appropriate.

## 6.2 Non-RCRA-Regulated CERCLA Waste

From Table 1, a non-RCRA regulated waste with a TRU concentration level of 23 nCi/g (Box 4) could go directly to an approved disposal facility if the waste package meets their WAC. The disposal facilities options listed include Hanford and Nevada Test Site. One criterion that would have to be achieved is to reduce the void space within the waste to the extent possible (DOE M 4.35.1-1, Chapter IV, G.1.d.2) and achieve long-term stability. In order to do this, the remaining space in the tank, approximately 604 gal, would be filled with grout resulting in the waste package having a TRU concentration level of 4 nCi/g. WCS has the capability to grout the tank and the disposal path is then outlined in Box 2. Disposal options listed include Envirocare, ICDF, Radioactive Waste Management Complex (RWMC), Nevada Test Site, and Hanford. ICDF is not a feasible option due to the ROD constraint, RWMC is an on-Site disposal facility and does not accept waste that has been treated off-Site, and lastly NTS and Hanford have size constraints. Envirocare is still the viable option for the grouted tank. Given this, the route outlined is transferring the waste package from the INEEL to WCS for grouting, then transferring the waste package to Envirocare for disposal.

## 6.3 Cost for Treatment and Disposal

An actual cost for the treatment and disposal of the waste package cannot be determined from the respective facilities. Several issues (i.e., dose rate issues, impact to facility process, characterization information) affect costs and cannot be evaluated at this time.

# 7. REFERENCES

Analytical Laboratory Log 84-021529.

Bragassa, Pat, (pwb@inel.gov), "Piping Weight Calculations," Jodi Bragassa, (joi@inel.gov), November 22, 2002.

10 CFR 61.55, 2002, "Waste Classification," *Code of Federal Regulations*, Office of the Federal Register, July 2002.

DOE G 435.1-1, 1997, "Packaging and Transportation Safety," U.S. Department of Energy, January 1997.

DOE-ID, 2002, "Title I (30%) Remedial Design for the Group 7, VES-SFE-20 Hot Waste Tank," DOE/ID-11010, Rev. 0, Idaho National Engineering and Environmental Laboratory, September 2002.

EDF-2360, 2002, "TRU Calculations for SFE-20 Waste Tank," Rev. 0, Idaho National Engineering and Environmental Laboratory, August 2002.

EDF-2381, 2002, "Miscellaneous Characterization Data for Hazard Classification of OU 3-13, Group 7, Hot Waste Tank VES-SFE-20," Rev. 1, Idaho National Engineering and Environmental Laboratory, November 2002.

NRC, 1995, *Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation, Revision in Part to Waste Classification Technical Position*, U.S. Nuclear Regulatory Commission, 1995.

# Appendix A

# Tank SFE-20 Piping Calculations

This page is intentionally left blank.

# Appendix A

# Tank SFE-20 Piping Calculations

Piping Material: 304L Stainless

| Pipe Identification | Unit Weight | Length of Pipe | | Weight |
|---|---|---|---|---|
| | PLF | LF | | Pounds |
| 4-in. inlet line | 10.89 | 3.5 | | 38.115 |
| 1-in. air sparger | 1.7 | 3.5 | | 5.95 |
| 1/2-in. liquid level indicator | 0.86 | 3.5 | | 3.01 |
| 1/2-in. sample line | 0.86 | 3.5 | | 3.01 |
| 2-in. pump suction line | 3.7 | 3.5 | | 12.95 |
| 1-in. sample port | 1.7 | 1 | | 1.7 |
| 2-in. vent port | 3.7 | 1 | | 3.7 |
| 2-in. acid fill | 3.7 | 1 | | 3.7 |
| 6-in. inspection hole | 18.97 | 1 | | 18.97 |
| 1-in. steam/condensate line | 1.7 | 27.83 | | 47.311 |
| | | | Sum = | 138.416 lb |

| Flange Weights: | Diameter | Thickness | Unit Weight PSI | Area Blind Flange | Weight Blind Flange |
|---|---|---|---|---|---|
| 4-in. inlet line | 9 | 0.94 | 0.2589 | 63.60525 | 16.46739923 |
| 1-in. air sparger | 4.25 | 0.5625 | 0.1684 | 14.1835781 | 2.388514556 |
| 1/2-in. liquid level indicator | 3.5 | 0.44 | 0.1325 | 9.6193125 | 1.274558906 |
| 1/2-in. sample line | 3.5 | 0.44 | 0.1325 | 9.6193125 | 1.274558906 |
| 2-in. pump suction line | 6 | 0.75 | 0.2231 | 28.269 | 6.3068139 |
| 1-in. sample port | 4.25 | 0.5625 | 0.1684 | 14.1835781 | 2.388514556 |
| 2-in. vent port | 6 | 0.75 | 0.2231 | 28.269 | 6.3068139 |
| 2-in. acid fill | 6 | 0.75 | 0.2231 | 28.269 | 6.3068139 |
| 6-in. inspection hole | 11 | 1 | 0.2963 | 95.01525 | 28.15301858 |
| 1-in. steam/condensate line | 4.25 | 0.5625 | 0.1684 | 14.1835781 | 2.388514556 |
| | | | | Sum = | 73.25552098 |
| | | | | Total weight: | 211.671521 lb |

Note: Table provided by Pat Bragassa, structural engineer, in email (Bragassa 2002).

This page is intentionally left blank.

# Appendix B

# SFE-20 Hot Waste Tank Disposal Facilities Waste Acceptance Requirements

This page is intentionally left blank.

# Appendix B

# SFE-20 Hot Waste Tank Disposal Facilities Waste Acceptance Requirements

## Envirocare

**(1) Meet Radioactive material license**
- •meet individual isotopic concentrations/per container – section 6& 8
- •waste classified as Class A
- •waste cannot be >10 nCi/g for treatment
- **• Prohibitions**
  - •sealed sources
  - •explosives
  - •generate toxic gases, vapors fumes
  - •not pyrophoric
  - •untreated biological, pathogenic, or infectious material
  - •liquid waste restrictions, < 1% of the volume of the waste
  - •no neutron source
- **•Containerized Radioactive Waste**
  - •waste package has been classified in accordance with R313-15-1008 and meet NCR Branch Technical Position on Concentration Averaging & Encapsulation
  - •mark as Class A Stable or Class A Unstable
  - •mark with unique package identification
- **•Special Handling**
  - •external gamma radiation levels shall not exceed 40mR/hr @ one meter from surface

**(2) Meet Waste Acceptance Guidelines**
- **•Waste Stream Qualification**
  - •Utah certified lab performs analysis
  - •after approved waste profile – generator sends pre-shipment samples
  - •hazard waste determination, radiological testing, to complete waste profile
- **•Disposal**
  - •oversize debris – application of grout to fill any void spaces
- **•Radionuclide Concentration Limits**
  - •the concentration is the average concentration per container for each radionuclide
  - •more than 1 radionuclide, classify by applying the sum of fractions rule
- **•Acceptable forms of Radioactive Waste**
  - •received radioactive waste in form of soil or debris
  - •oversize debris – filled containers or other oversize debris
  - •some bulk oversize debris require state approval
- •Prohibited Hazardous Waste Codes
  - •F020, F021, F022, F023, F026 & F027, Utah waste codes F999, P999
- •Waste Treatment Evaluation Review
  - •characterize & profile waste stream
  - •send pre-shipment samples (5-1 liter, no hold times)

**(3) Transportation & Delivery**
- •accepts rail & truck
- •minimum, strong-tight containers meeting DOT (package prevents leakage of the radioactive content under normal conditions of transportation in 49 CFR

## Hanford

**(1) General Requirements**
- •Waste verification required at the INEEL if:
  - •Remote handled
  - •Container exceeds 10'x5'4" (includes lifting bails, flanges, etc)
  - •Containers >7,000 lbs.
  - •Other waste to be treated or packaged in a form that cannot be inspected easily subsequent to treatment or packaging
- **•Unlined LLBG Requirements**
  - •Package dose rates <200 mrem/hr contact and <100 mrem/hr @ 30 cm CH waste exceeding these limits require container specific review and approval
  - •Package to meet 49 CFR 173.410
  - •Container must meet one of the following:
    - •Metal, concrete, or masonry
    - •Wood (pretreated or painted with fire retardant paint
    - •Rigid plastic
    - •Flexible plastic if waste is metal
  - •Large heavy items must be secured by bracing, blocking or other means. Shielding must be secured if used
  - •Containerized waste must fill at least 90% of the internal volume of the outer container
  - •Packaging in a HIC or placed in a Hanford provided HIC or monolith
- **•Lined LLBG Requirements**
  - •No CERCLA waste unless management @ Hanford is specified in the ROD
- •Central Waste Complex Requirements
  - •For wastes requiring treatment prior to disposal
  - •Can store CERCLA waste
  - •Sorbtion of liquids is allowed, but must be compatible with treatment. Must be enough to absorb condensate
  - •<100 mrem/hr @ 30 cm and <200 mrem/hr @ contact with package
  - •Package must meet 49 CFR requirements. Outer container shall be noncombustible material
  - •Secure waste and shielding
  - •Package size no greater than 10'x11' and 2,000 lbs/ft$^2$
- •T-Plant Facility Requirements
  - •No CERCLA waste unless management @ Hanford is specified in the ROD
- •WRAP Requirements
  - •No CERCLA waste unless management @ Hanford is specified in the ROD

**(2) Transportation & Delivery**
- •meet DOT regulations

## Nevada Test Site

**(1) General Requirements**
- **•Waste Criteria**
  - •Greater than Class C not accepted
  - •No off-site mixed waste
  - •Free liquid <1% of waste in disposal container
  - •Must be treated to reduce volume and provide more stable waste form
  - •PCBs in waste <50 ppm
  - •Asbestos LLW
- **•Waste Package Criteria**
  - •Closure must be sturdy enough that it will not be breached under normal handling
  - •Can use lead shielding but must document that regular packaging would not reduce exposure rate to 5 mrem/hr @ 30cm.
  - •Outer package cannot be radioactively contaminated
  - •Strength must support 3,375 lbs/ft$^2$
  - •Removable skids preferred to meet NTS PA
  - •Size – Boxes 4'x4'x7' or 4'x 2'x7' or 55-gal drums should be used. Alternate packages will be considered upon consultation. Bulk packages may be considered for disposal unpackaged. However, contamination must be fixed, covered or contained sufficiently for safe transfer
  - •Weight limits don't apply to bulk waste
  - •Interior volume is efficiently and compactly loaded to minimize void space
- **•Waste Characterization**
  - •MW must demonstrate it meets LDRs
  - •Isotopic distribution and corresponding activity concentrations
  - •Physical, chemical, and radiological properties
  - •UHCs
  - •A portion of all data shall be validated
- **•Appendix A**
  - •Waste package certified by a waste certification official
- **•Appendix E**
  - •Waste activity concentration shall be determined on the volume of the final waste form as offered for disposal
  - •Volume of the waste can usually be taken as the internal volume of the container if the radionuclides are reasonably homogeneously distributed throughout the waste and the waste fills at least 90% of the waste container
  - •If the package contains significant void space or contains irregularly shaped equipment or components, the volume shall be taken as the volume occupied by the waste in the container

**(2) Transportation & Delivery**
- •meet DOT regulations

## Waste Isolation Pilot Plant

**(1) General Requirements**
- **•Waste Criteria**
  - •Accept TRU-mixed co-mingled with asbestos
  - •WAC covers contact handled only-no remote handled permit
  - •Defense TRU waste (have approved defense related determination)
  - •Plans will contain details of the process, controls, techniques, tests and other actions applied to each container, waste stream and shipment
  - •Transmit information using WWIS
  - •Report and track Am-241, Pu-238, Pu-239, Pu-240, Pu-242, U-233, U-234, U-238, Sr-90 and Cs-137
  - •Payload containers shall contain >100 nCi/gm of waste
  - •Waste shall not contain PCBs > or = to 50ppm
  - •Can't accept high-level or spent nuclear fuel
  - •must use an approved certification program
- **•Waste Package Criteria**
  - •55-gal drums (direct loaded or containing a pipe component)
  - •SWB (direct loaded or containing up to 4 direct loaded 55-gal drums or containing one bin)
  - •Ten drum overpacks (TDOPs, containing up to ten direct loaded 55-gal drums, 6 85-gal overpacks or one SWB)
  - •meet DOT 7A, Type A metal and be in good and unimpaired condition. 100% visual examination. Documented by Appendix D checklist
  - •Weight limits
  - •Rad properties – 2 groups (ten WIPP-tracked isotopes and FGE, PE-Ci and decay heat of the payload container). PE-Ci calculated for each payload container
  - •Rad dose rates <200 mrem/her @ surface
  - •No liquids - < 1% by volume of the payload container
  - •Pyrophoric, <1% by weight generally dispersed
  - •TRU content >100 nCi/g

**(2) Transportation & Delivery**
- •meet DOT regulations
- •must use TRUPACT II, 72-B, half pack with appropriate payload containers